EKG TECH BASICS · ONE-PAGER

Exercise and Pharmacologic Stress Testing

Contraindications, preparation and Mason-Likar placement, Bruce stages, target heart rate, METs and Borg, monitoring and recovery, when to stop, the ST response, stress drugs, and the technician's role

17 sources + more detail

ekgtechbasics.com/sheets/ekg-stress-testing.html
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1 Before the test

An exercise test records a 12-lead ECG, blood pressure and symptoms as the workload rises in steps. A drug replaces exercise when the patient cannot exercise adequately.

Carluccio 2026, adapted from the AHA exercise standards; BP figure from Merck.

ABSOLUTE: THE TEST DOES NOT START	RELATIVE: THE CLINICIAN DECIDES
Infarction within 2 days; high-risk unstable angina	Known left main stenosis; moderate aortic stenosis
Uncontrolled arrhythmia with hemodynamic compromise	Uncontrolled-rate tachyarrhythmia; acquired complete heart block
Symptomatic severe aortic stenosis; decompensated heart failure	Obstructive hypertrophic cardiomyopathy with a severe resting gradient
Acute PE, myocarditis, pericarditis, aortic dissection or pneumothorax; active endocarditis	Resting BP over about 200/110 mm Hg; recent stroke or TIA
A disability that makes testing unsafe	Marked anemia, electrolyte imbalance, hyperthyroidism; limited cooperation

⚠ SAFETY The technician does not weigh contraindications. Hold the test and show the clinician: new chest pain, a new ECG change or block, resting BP still over about 200/110 on a repeat reading, or missing consent.

- Verify the order, two identifiers and consent. Explain: it starts at a walk, gets faster and steeper about every 3 minutes, and symptoms are reported at once.
- No food, tobacco, caffeine or alcohol for about 3 hours, often no caffeine for 24; walking shoes. Vasodilator scans: no caffeine for at least 12 hours (label; Merck says 24). Follow the lab's own times.
- Medicines only as the provider directs (beta blockers blunt the rate rise). Report sildenafil, tadalafil or vardenafil taken in the past 24–48 hours: nitrates for chest pain could then drop the BP dangerously.
- Clip, clean and lightly abrade the skin. Mason-Likar: arm electrodes just below the outer clavicles, leg electrodes above the iliac crests, chest leads as usual (see Electrode and Lead Placement). Record and label the resting baseline in this layout.
- Defibrillator and crash cart checked and at hand.

2 Numbers to know

MEASURE	HOW	EXAMPLE
Predicted maximum heart rate	220 − age	Age 45: 175/min
Target heart rate	85% of predicted maximum	175 × 0.85 = 149/min
METs	$VO_2 \div 3.5$ (1 MET = 3.5 mL O_2/kg/min)	VO_2 31.5 → 9 METs
Borg RPE	6 (none) to 20 (maximal)	Maximal effort: over 17 (or 18 and up)
Rate-pressure product	Heart rate × systolic BP	154 × 186 = 28,644
Chronotropic incompetence	Peak under 80% of predicted	Age 60, peak 120: 75%

EXAM TIP 85% of predicted marks an adequate test, not always the end: many labs continue to exhaustion unless a stop criterion appears, so follow the order. A patient on a beta blocker who stops at Borg 18 below target gave a maximal effort. Adenosine and regadenoson use no target rate.

3 Treadmill protocols

Speed and grade rise together every 3 minutes; METs are estimates.

BRUCE STAGE (3 MIN)	SPEED (MPH)	GRADE	ABOUT METS
1	1.7	10%	4.6
2	2.5	12%	7.1
3	3.4	14%	9.6
4	4.2	16%	12
5	5.0	18%	14.5
6	5.5	20%	16.8
7	6.0	22%	19.3

- Modified Bruce: two 3-minute stages at 1.7 mph, 0% then 5%, then Bruce stage 1; for older or deconditioned patients.
- Naughton: small stages of about 1 MET, for low capacity or heart failure. Cycle protocols step up in watts.
- Aim for 8–12 minutes of exercise; repeat tests on the same protocol.

4 Monitoring through recovery

- ECG continuously; a 12-lead at rest (supine and standing), at the end of each stage, at peak, at 1, 2, 4 and 6 minutes of recovery, and at any change.
- BP at rest, each stage (or every 2 minutes), peak and recovery: by hand on a treadmill; confirm any abnormal automatic reading manually.
- Symptoms and Borg each stage; watch gait, color and sweating.
- Recovery: slow the belt gradually, then seat the patient for at least 6 minutes or until near baseline (patients are told to expect 10–15 minutes); lie a symptomatic patient down. ST depression only in recovery still counts.

⚠ SAFETY Collapse, no response or no normal breathing: call the code team, start CPR, and use the AED as trained.

5 When to stop

Carluccio 2026, adapted from the AHA exercise standards; Carluccio puts the BP limit in the absolute column.

ABSOLUTE: EXERCISE STOPS NOW	RELATIVE: REPORT AT ONCE; CLINICIAN DECIDES
ST elevation over 1 mm in leads without Q waves (not aVR, aVL, V1)	Horizontal or downsloping ST depression over 2 mm
Systolic fall over 10 mm Hg below baseline as workload rises, with other signs of ischemia	The same fall without other signs of ischemia
Typical angina	Increasing chest pain
Dizziness, ataxia, near syncope; cyanosis or pallor	Fatigue, dyspnea, wheezing, leg cramps, claudication
Complex ventricular or any output-limiting arrhythmia	New bundle branch block that cannot be told from VT
ECG or BP cannot be monitored; the patient asks to stop	BP over 250/115 (sources class it differently)

EXAM TIP Exams return to three absolutes: the patient's request (honor it, even below target), a tracing or BP that cannot be monitored (sweat-loosened electrodes end the test), and ST elevation.

6 Reading the ST response

FINDING (80 MS AFTER THE J POINT)	READS AS
Horizontal or downsloping depression of 1 mm or more in 3 beats in a row	Positive (ischemic)
Slowly upsloping depression over 1.5 mm	Abnormal
J-point depression, rapidly upsloping ST under 1.5 mm	Normal exercise response
ST elevation of 1 mm or more, leads without Q waves	Ischemia; stop

Measure from the PR baseline; above 130/min read at 60 ms. LBBB, ventricular pacing, pre-excitation or resting ST depression of 1 mm or more make ST changes unreadable, and so does digoxin therapy; these patients go to imaging, often with vasodilator stress.

7 Pharmacologic stress

AGENT	WHAT IT DOES	WATCH FOR
Adenosine	Infusion; coronary vasodilator; half-life under 10 seconds	Flushing, chest discomfort, dyspnea; AV block (about 6%), hypotension, bronchospasm, AF; fades fast when stopped
Regadenoson	One rapid injection; selective coronary vasodilator	Dyspnea, headache, flushing; AV block, AF, low or high BP, seizure; most reactions settle in about 15 minutes
Dobutamine	Infusion raised every 3 minutes; raises rate and contractility toward the 85% target	Frequent PACs or PVCs, AF, nonsustained VT, BP swings, chest pain; beta blockers blunt it

⚠ SAFETY Before a vasodilator, report second- or third-degree AV block or sinus node disease without a working pacemaker, and asthma or wheezing. Caffeine blocks both vasodilators.

8 Technician and clinician

The technician prepares the patient and room, runs the protocol, records ECG, BP, symptoms and Borg, reports changes at once, stops the treadmill for an absolute criterion or the patient's request per protocol, calls for help, and starts CPR and uses the AED when trained. The supervising clinician decides on contraindications and medicines and on relative criteria, gives and stops every stress drug, and interprets the test.

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